Novel Insect Trap Useful in Capturing Sap Beetles (Coleoptera: Nitidulidae) and Other Flying Insects

PATRICK F. DOWD, ROBERT J. BARTELT[1], AND DONALD T. WICKLOW

Mycotoxin Research Unit, National Center for Agricultural Utilization Research, USDA–ARS, 1815 N. University St., Peoria, Illinois 61604

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ABSTRACT A novel trap designed to catch sap beetles and many other insects is described. This trap is durable, being manufactured from PVC pipe and brass screen. The modular trap orients in the wind such that air flows over screened-off bait compartments and through a screen funnel entrance. Insects approach and enter from down-wind and become trapped after passing through a wire mesh funnel. They subsequently move through a connecting tube, through an additional funnel, and into a removable collector. Catches of sap beetles were superior to a commercially available Japanese beetle trap. Several thousand sap beetles (primarily *Carpophilus lugubris* Murray) could be captured with appropriate baits over a 1-wk period. Fungi from the trapped sap beetles included *Aspergillus flavus* Link:Fr. and numerous common genera with species recognized as plant pathogens, entomopathogens, saprophytes, or biocontrol agents. Other families of insects that contain pests and were captured include Cantharidae, Chrysomelidae, Elateridae, Culicidae, Drosophilidae, Muscidae, Vespidae, and Noctuidae.

KEY WORDS *Insecta*, insect trap, sap beetles, *Carpophilus*

INSECT TRAPS are nearly as variable as the insects they catch. Colors, capture mechanisms, and overall designs vary. Among the earliest traps developed are those involving funnels and sticky materials. Other types in common use include "bucket," collision, and collection traps involving crossed vanes and collecting funnels.

Sap beetles are important pests of fruits and vegetables as well as stored products (Hinton 1945, Connell 1956). These beetles also vector a variety of microorganisms, including the fungi that produce aflatoxin (Lussenhop & Wicklow 1990). Monitoring populations of these insects has often involved trapping. Traps have also been used successfully to reduce populations of some species of nitidulids (Warner 1960, 1961). Among the trap designs previously used are baited "cans" (Luckmann 1963, Foote et al. 1976), Japanese beetle-type vane traps (Alm et al. 1985), modified gypsy moth traps (Alm et al. 1986), and glass jar-based funnel traps (Smilanick et al. 1978). A comprehensive study of known traps potentially useful for capturing sap beetles has been reported recently (Peng & Williams 1991). Our initial attempts at using "sticky traps," vane traps, and funnel-in-jar traps under field conditions resulted in relatively poor collections compared with baited tin cans (which allowed the beetles to enter and depart freely). Further examination of the traps in laboratory settings with sap beetles such as the driedfruit beetle, *Carpophilus hemipterus* (L.), and the dusky sap beetle, *Carpophilus lugubris* Murray, indicated obvious problems with each trap type. With funnels in jars, attractive odors did not appear to be emitted at a sufficient rate to be attractive compared with fully exposed baits. These two species of *Carpophilus* were found to be very agile flyers and landers, such that collisions with vane-type traps were infrequent; instead, the beetles landed directly on the vanes. The sticky materials would not hold the beetles; they walked rapidly across and escaped from a commercially coated Delta trap (Pest Management Supply Company, Amherst, Mass.). Even when card stock coated heavily with Tanglefoot (Pest Management Supply Company, Amherst, Mass.) was used, the beetles were able to escape within 1 h. Thus, it was necessary to develop a trap that would readily release attractive volatiles, yet be able to catch agile insects not prone to capture with sticky materials. Such a trap, constructed primarily of polyvinyl chloride (PVC) pipe and screen wire, with an attachment to promote wind orientation, is described herein. A modification that permits monitoring the presence of fungi or other microorganisms carried by insects is also described.

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[1] Bioactive Constituents Research Unit, National Center for Agricultural Utilization Research, USDA–ARS, 1815 N. University St., Peoria, Illinois 61604.

ganisms (Fig. 2) during washing. Placement of funnels up inside the tube as opposed to the end of the tube helped reduce damage. Silicone cement appeared to be more useful in securing parts where flexing occurred, such as the vial lids. In some cases, large insects plugged the end of the polyethylene funnel. As indicated earlier, this problem was solved by inserting an excluder screen in the neck of the tee before the end with the funnel, such that the holes in the screen were slightly smaller than that of the polyethylene funnel. Other useful refinements included use of plastic-coated multistrand wire to suspend traps, again apparently because it would endure more flexing than single-strand wire. Use of the partially horizontally mounted fin increased response to wind direction but interfered somewhat with beetle landings.

Overall, however, the traps were typically very durable throughout the several-month exposure periods. These traps were unbreakable, and the materials did not rust or photodegrade. Although somewhat costly (≈$2.50 each in materials) compared with paper sticky traps, the traps are made from readily available materials. Availability of different size and color pipe from plumbing supply houses allows for ready construction of different traps appropriate for different sized insects. Use of molded screen (e.g., Fiberglas) would be useful for other insects and is likely to be less expensive. Where contact with baits is not a concern, the bait could be enclosed inside the tee without the extra bait compartment, as could the funnel if longer-armed tees were available. The modular organization allows for many different variations to be applied to a basic design.

These traps are more durable than those based on glass Mason jars and do not contaminate insects as do sticky-type traps. Insects can be recovered live readily, especially if the traps are checked frequently or food is placed in the collecting vial–cup–bag. Similarly, insects can be readily killed by incorporating insecticide or soapy liquids in these same compartments. Use of the fin allows the traps to orient in the wind such that odors exit the funnel end of the trap and allow insects to approach upwind and enter the traps. The design lends itself to monitoring microbial contaminants of insects because it can be immersed in a disinfectant solution between collections. Use of appropriate baits and modification of traps to allow entry of insects of the desired size should allow this trap to be used to capture virtually any species of flying insect.

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